

EM70 Servo Controller Instruction Manual

Thank you for purchasing a Shimaden product.
Please check that the delivered product is the correct item you ordered. Please do not begin operating this product before you read this instruction manual thoroughly and understand its contents.

Notice

Please ensure that this instruction manual is provided to the final user of the instrument.

Preface

This instruction manual is meant for those who will be involved in the wiring, installation, operation and routine maintenance of the EM70. It describes matters to be attended to in handling the EM70, how to install it, its wiring, its functions and its operating procedure. Keep this manual at the work site while handling the instrument and follow the guidance provided herein.

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1. Safety Rules

For matters regarding safety, potential damage to equipment and/or facilities, additional instructions and notes are indicated by the following headings.

⚠ WARNING

This heading indicates hazardous conditions that could cause injury or death of personnel unless extreme caution is exercised.

⚠ CAUTION

This heading indicates hazardous conditions that could cause damage to equipment and/or facilities unless extreme caution is exercised.

NOTE

This heading indicates additional instructions and/or notes.

The mark \oplus represents a protective conductor terminal. Make sure to ground it properly.

⚠ WARNING

The EM70 is designed as control instruments designed for industrial use to motor and/or other industrial equipment. Avoid using it for control of devices upon which human life is sustained. When used, adequate and effective safety measures must be taken. No warranty is valid in the case of an accident arising from the use of this product without first undertaking such safety measures.

- For using this instrument, house it in a control box or the like lest its terminals come into contact with a person.
- Do not draw out the instrument from its case. Do not insert your hand or any conductive body in the case. That action may lead to serious injury or death due to an electric shock.
- Make sure to ground protective conductor terminals.
- During preparatory adjustment and operation of this instrument, operating terminals (dampers, valves, etc.) are put into action in the entire range of their motions. You should ensure safety in their movable ranges before operation.

⚠CAUTION

To avoid damage to connected equipment, facilities or the EM70 itself due to a fault of the product, safety measures must be taken before usage, such as the installation of a fuse, an overheating protection device or the like. No warranty is valid in the case of an accident arising from the use of this product without such safety measures having been undertaken.

- The alert mark ⚠ on the plate affixed to the instrument:
On the terminal nameplate affixed to the case of this instrument, the alert mark ⚠ is printed. This is to warn you of the risk of electric shock which may result if the terminal is touched while being energized.
- As a means to turn the power off, a switch or a breaker should be installed in the external power circuit to be connected to the power terminal of the instrument. Fix the switch or the breaker adjacently to the instrument in a position which allows it to be operated with ease, with an indication that it is a means of turning the power off. Use a switch or a breaker which meets IEC60947 requirements.
- Fuse: Since the instrument does not have a built-in fuse, do not forget to install a fuse in the power circuit to be connected to the power terminal.
Fuse rating/characteristics: 250 VAC 0.5 A/medium lagged or lagged type.
Use a fuse which meets IEC60127 requirements.
- Voltage/current of a load to be connected to the output terminal and the alarm terminal should be within a rated range. Otherwise, the temperature will rise to reduce the life of the product and/or to result in problems with the product.
For rated voltage/current, see "10. Specifications".
The output terminal should be connected with a device which meets IEC61010 requirements.
- A voltage/current different from that of the input specification should not be applied to the input terminal. It may reduce the life of the product and/or result in problems with the product.
For rated voltage/current, see "10. Specifications".
In the case of voltage or current input, the input terminal should be connected to a device which meets IEC61010 requirements.
The instrument is provided with a draft hole for heat discharge.
Take care to prevent metal and other foreign matter from entering this hole. Failure to do so may result in trouble with the instrument or may even cause a fire.
- Do not block the draft hole or allow dust or the like to stick it. A rise in temperature or insulation failure may result in a reduction of the life of the product and/or problems with it or may cause a fire.
For spaces between installed instruments, refer to "3-4. External Dimensions and Panel Cutout".
- It should be noted that repeated tolerance tests against voltage, noise, surge, etc. may lead to deterioration of the instrument.
- Users are prohibited from remodeling the product or abnormal use thereof.
- It takes 30 minutes to display the correct data after applying power to the digital controller. (Therefore, turn the power on more than 30 minutes prior to the operation.)
- To ensure safety and maintain the functions of this device, do not disassemble this device. If this device must be disassembled for replacement or repair, contact your nearest dealer.
- This device is designed for mounting on the panel. Only the device mounted on the front of the panel facing outward is of protection class of IP66. Do not use for the device not facing outward or in environment where water or solids in excess of IEC60529 may get inside.

2. Introduction

This instrument, connected to a control motor to rotate the motor shaft, is capable of adjusting opening/closing of valves and the like. Event output, analog output and communication functions are included as options.

2-1. Check before Use

This product has been fully inspected for quality assurance prior to shipment. Nevertheless, you are requested to make sure that there is no error, damage or shortage of delivered items by checking the model codes and the external view of the product and the number of accessories.

1. Confirmation of Model Codes

Check the model codes affixed to the case of the product to ascertain if the respective codes designate what was specified when you ordered it, referring to the following code table:

Example of model codes:

EM70 - 4 Y - 0 0 0 0
1 2 3 4 5 6 7 8

1. Series	EM70
2. Input	4: Current 4 to 20mA, 0 to 20mA DC 6: Voltage 1 to 5V, 0 to 5V, 0 to 10V DC
3. Output type	Y: Contact 240V AC 2A with CR absorber R: Contact 240V AC 2A without CR absorber S: Combination of SSR and contact 240V AC 2A
4. Event output	0: Without 1: Contact output
5. Analog output	0: Without 4: 4 to 20mA DC
6. Square root extraction	0: Without 1: With function
7. Communication	0: Without 5: RS-485 7: RS-232C
8. Remarks	0: Without 9: With

2. Accessories

This instruction manual 1 copy
The Communication instruction manual..... 1 copy
(when the optional communication function is added)

Note: For any problem with the product, shortage of accessories or request for information, please contact our representative.

2-2. Handling Instruction

1. Do not operate the keys on the front panel with a hard or sharply pointed object. Operate the keys only by softly touching them with fingertips.
2. When cleaning the instrument, wipe it softly with a dry cloth. Never use solvents such as thinner

3. Installation and Wiring

3-1. Installation Site (environmental conditions)

⚠CAUTION

This instrument should not be used in any of the places mentioned below. Selection of these places may result in trouble with the instrument, damage to it or even a fire.

1. Where flammable gas, corrosive gas, oil mist and particles that can deteriorate electrical insulation are generated or abundant.
2. Where the temperature is below -10°C or above 50°C.
3. Where the relative humidity is above 90% RH or below the dew point.
4. Where highly intense vibration or impact is generated or transferred.
5. Near high voltage power lines or where inductive interference can affect the operation of the instrument.
6. Where the instrument is exposed to dew drops or direct sunlight.

- 7. Where the height is above 2000m.
- 8. Outdoors.

Note: The environmental conditions belong to the installation category II of IEC60664 and the degree of pollution is II.

3-2. Mounting

⚠ CAUTION

For safety's sake and to protect the functionality of the product, do not remove its body from the case. If it needs to be drawn out for replacement or repair, call our sales office in your neighborhood.

1. Cut a hole for mounting the controller in the panel by referring to the cutout drawing in Section 3-4.
2. The panel thickness should be 1.0 to 4.0 mm.
3. As the instrument is provided with pawls for fixing, just press it firmly from the front of the panel.
4. The EM70 is designed to be mounted on a panel. Never use it without mounting on the panel.
5. In case if the gasket is broken or falls off, please replace it with the designated one.

3-3. Wiring

⚠ WARNING

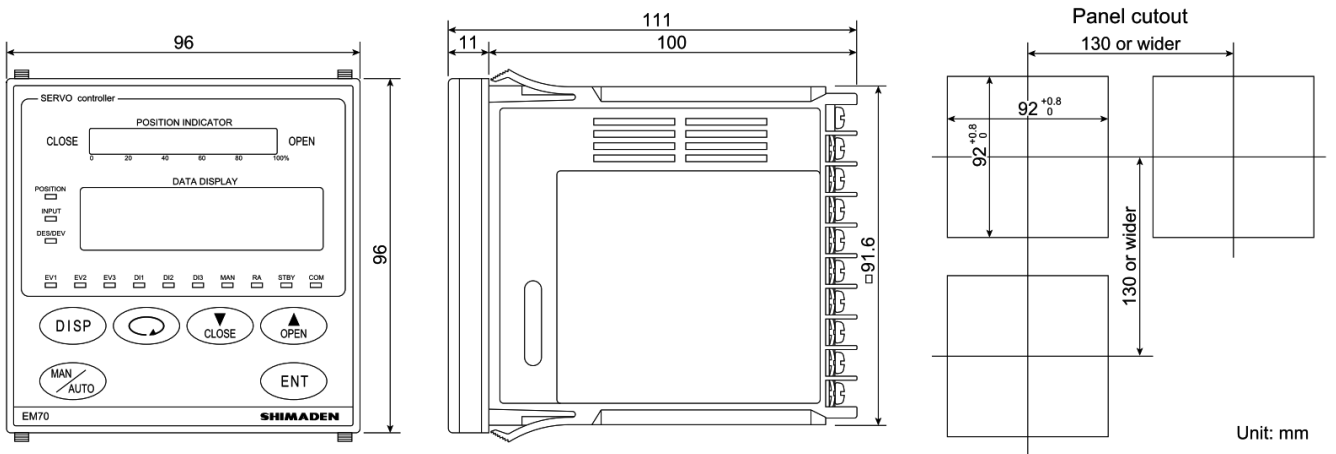
- When wiring, make sure to disconnect the power supply. Otherwise an electric shock may result.

Make sure to ground the protective conductor terminal (⊕). Otherwise you may receive an electric shock.

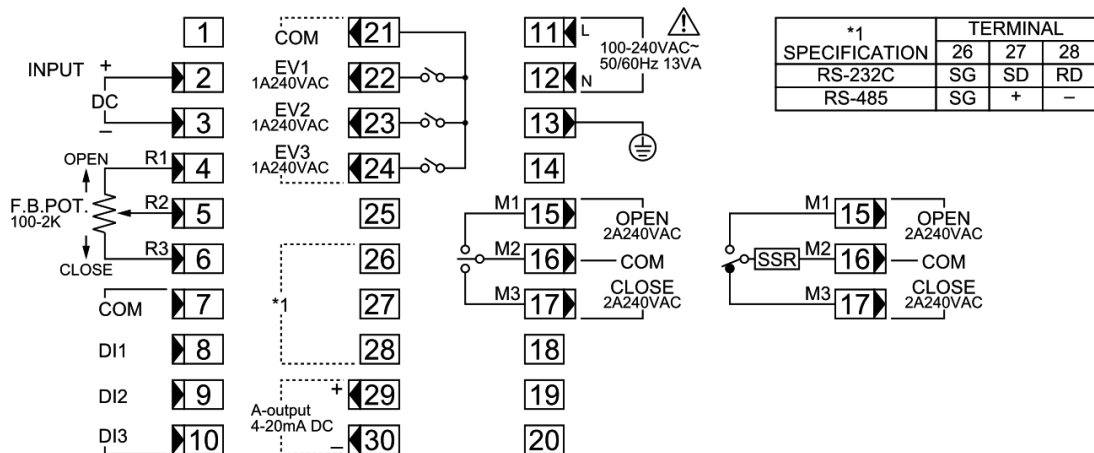
- After wiring, do not touch terminals or other charged elements while it is energized. Otherwise an electric shock may result.

1. Follow "3-5 Terminal Layout" and "3-6 Terminal Arrangement Table" and make sure to conduct wiring correctly.
2. The press-fit terminal must fit an M3.5 screw and have a width of 7 mm or smaller.
3. The input signal wire must not be accommodated with a high-voltage power cable in the same wiring conduit or duct.
4. Shielded wire (one-point grounding) is effective to avoid electrostatic induction noise.
5. Twisting the input wires at short and equal intervals is an effective way to avoid magnetic induction noise.
6. For wiring for power supply, use a 600V vinyl insulated wire or cable which is 1 mm² or larger in section or a wire or cable of equivalent for higher performance.
7. The wire for grounding must be 2 mm² or larger in section and must be grounded at a grounding resistance of 100Ω or lower.
8. Clamp the terminal screws firmly.
Clamp receiving torque: 1.0N.m (10 kgf.cm)
9. Countermeasure against lightning surge will be required for signal line over 30m.

3-4. External Dimensions and Panel Cutout



3-5. Terminal Layout

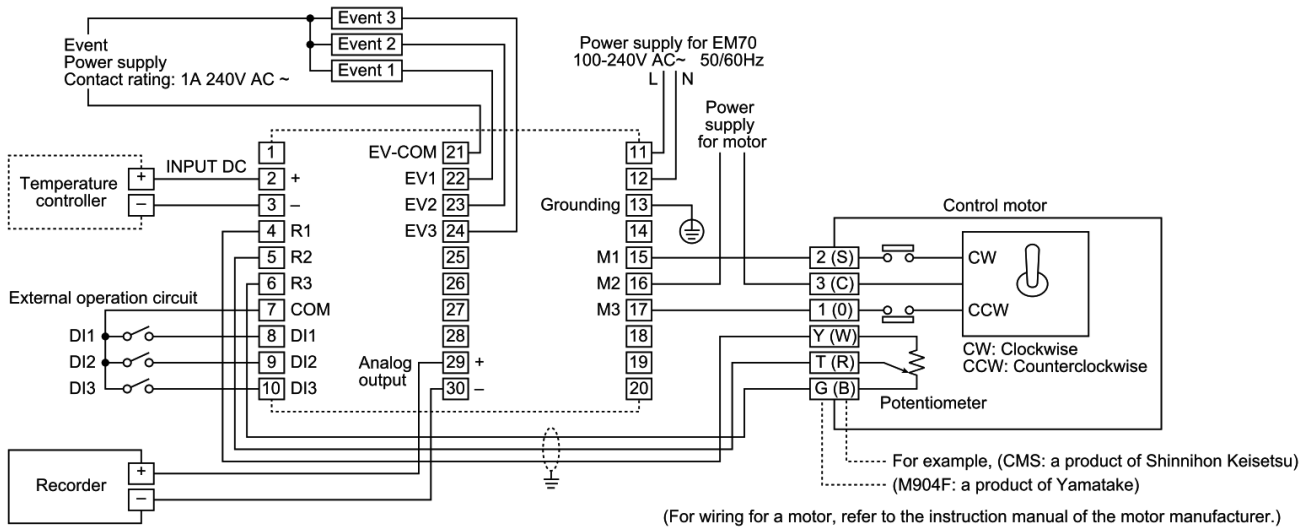


3-6. Terminal Arrangement Table

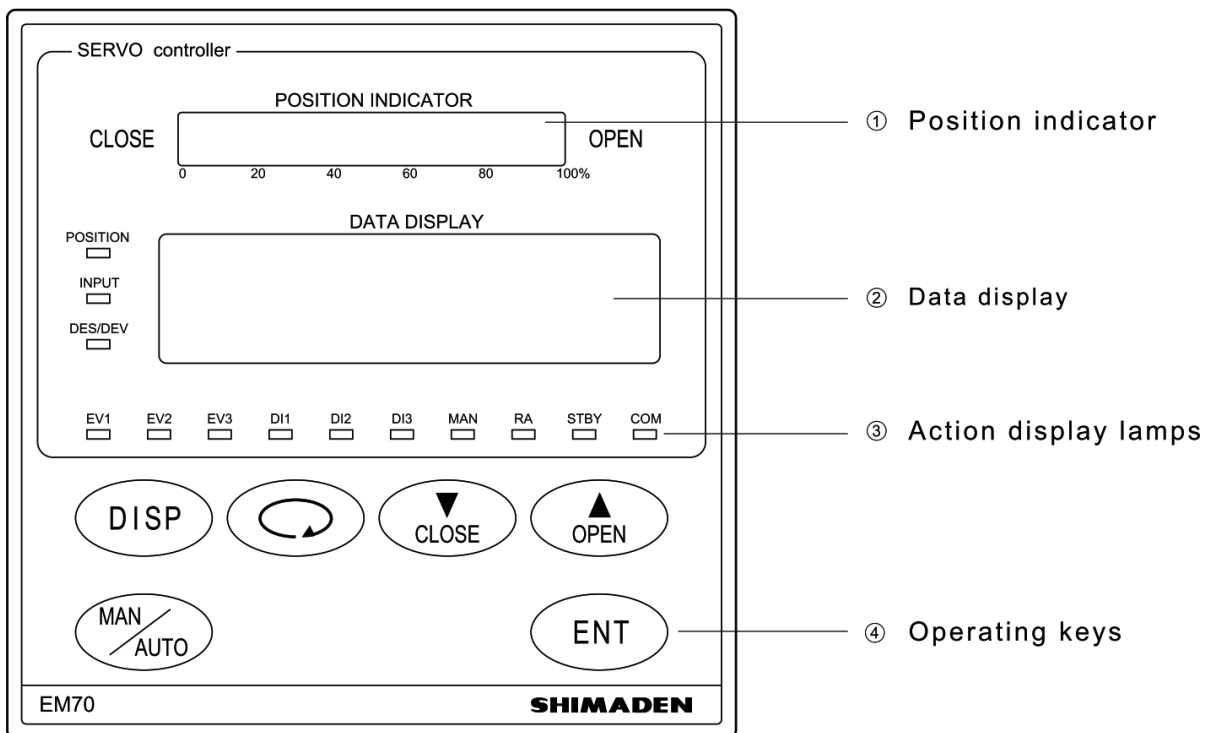
Name of terminal	Description and Code	No.	Name of terminal	Description and Code	No.	
Power supply	100 to 240V AC±10%	L	External operation input	COM	7	
	50/60Hz 13VA	N		DI1	8	
Protective conductor	Protective grounding (⊕)	13		DI2	9	
				DI3	10	
Control input	Voltage/Current	+	Event output (option)	Contact COM	21	
		-		Contact EV1	22	
Control output	Contact as well as SSR	M1 OPEN	Contact EV2	23		
		M2 COM	Contact EV3	24		
		M3 CLOSE				
Feedback potentiometer input	OPEN	R1	Communication (option)	RS-232C: SG	RS-485: SG	26
	F.B.POT	R2		SD	+	27
	CLOSE	R3		RD	-	28
			Analog output (option)		+	29
					-	30












3-7. Wiring Example

An example of wiring is shown. Particular attention should be paid to common lines and polarity.



4. Names and Functions of Parts on Front Panel



Name	Function
① Position display (green)	(1) The present position is shown by a percentage (0 to 100%) of opening in the form of bar graph. (green) (2) The bar graph displays 20 dot (resolution of 5%). Lights when position value goes above 2.5%, lights full when above 97.5%. Turns off when below 2% with 0.5% of hysteresis.
② Data display (green)	(1) Position (degree of opening) is displayed usually but display changes every pressing of the  key from INPUT to DES (set value of position) and to DEV (deviation). (Position, input, target degree of position and deviation displays) (green) (2) Set value and item are displayed on each parameter screen.
③ Action display lamps	<p>(1) POSITION (green) lights when display of present position is selected.</p> <p>(2) INPUT (green) lights when control input display is selected.</p> <p>(3) DES/DEV (green) lights when target position display or deviation display is selected.</p> <p>(4) EV1 (orange) lights when Event 1 is in action.</p> <p>(5) EV2 (orange) lights when Event 2 is in action.</p> <p>(6) EV3 (orange) lights when Event 3 is in action.</p> <p>(7) DI1 (green) lights when external input (DI1) is ON.</p> <p>(8) DI2 (green) lights when external input (DI2) is ON.</p> <p>(9) DI3 (green) lights when external input (DI3) is ON.</p> <p>(10) MAN (green) flashes during manual operation and remains off during automatic operation.</p> <p>(11) RA (green) lights during reverse action (RA) and remains off during direct action (DA).</p> <p>(12) STBY (green) lights when stand-by is selected in operation/suspension switching. It remains off during ordinary operation.</p> <p>(13) COM (green) lights when COM (reading/writing) is selected for communication and goes out when LOC (reading) is selected.</p> <p>(14) OPEN (green) lights when opening control output (OPEN) is ON. Conducting across terminals M1 and M2.</p> <p>(15) CLOSE (green) lights when closing control output (CLOSE) is ON. Conducting across terminals M2 and M3.</p>
④ Operating keys	<p>(1)  (display) key</p> <p>① While the EM70 is in ordinary operation, this key is used to change the display. Each pressing of it changes the display in the following order: Position value → input value → target position value → deviation value → position value.</p> <p>② Display returns to the initial screen of a screen group, such as "1-0 or 1-00 zero span adjustment screen" in screen group 1 or "2-0 screen for setting delay time on occurrence of position error" in screen group 2. From the initial screens of screen groups 1 and 2, it returns to "0-0 basic screen."</p> <p>(2)  (parameter) key</p> <p>① Used to proceed from a parameter setting screen to the next parameter setting screen.</p> <p>② By pressing this key continuously for 3 seconds on "the 0-0 basic screen," you can proceed to "The 1-0 or 1-00 Zero span adjustment screen."</p> <p>(3)  (down) key</p> <p>① Used to decrease a numerical value on a numerical value setting screen.</p> <p>② Used to select an item on a screen for selection.</p> <p>③ During manual operation (MANUAL), closing control output (CLOSE) turns ON.</p> <p>(4)  (up) key</p> <p>① Used to increase a numerical value on a numerical value setting screen.</p> <p>② Used to select an item on a screen for selection.</p> <p>③ During manual operation (MANUAL), opening control output (OPEN) turns ON.</p> <p>(5)  (entry/registration) key</p> <p>① On each parameter screen, a value set or an item selected by means of the  or  key is registered by pressing this key.</p> <p>② When pressed continuously for 3 seconds on "1-0 zero/span automatic control screen," automatic span adjustment is carried out.</p> <p>③ When pressed continuously for 3 seconds on "1-00 zero/span automatic control screen," the display changes to the zero manual adjustment screen.</p> <p>(6)  (manual/automatic) key</p> <p>① Pressing this key on "the 0-0 basic screen" continuously for 2 seconds changes automatic operation to manual operation. (This can be done alternatively by pressing the  key and the  key simultaneously.)</p> <p>② When pressed continuously for 2 seconds in manual operation (MANUAL), manual operation (MANUAL) is released to return to automatic operation (AUTO).</p> <p>③ By pressing this key on a setting screen of the screen group 1, you can go back to the screen preceding it.</p>

5. Before Starting Up

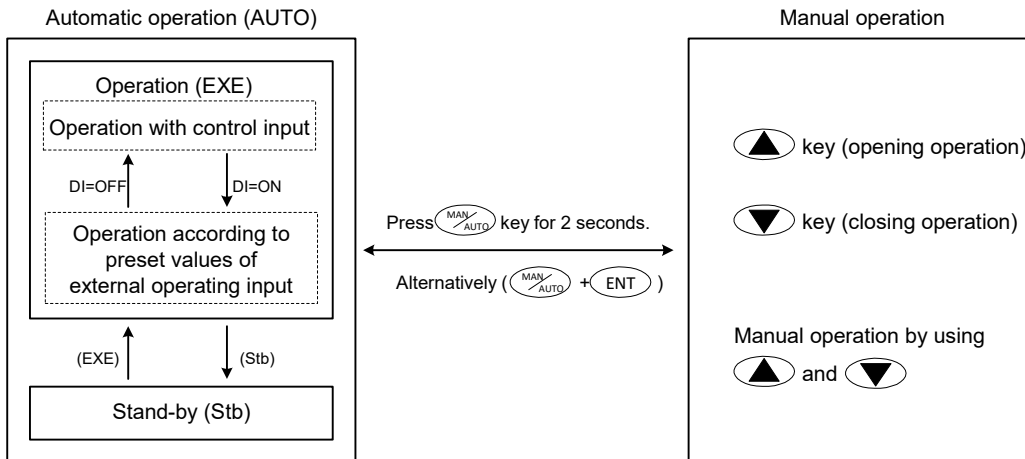
In the following, those matters requiring your attention before starting operation are described.
For the operating procedure and setting, refer to 7. Explanation of Screens and Parameter Setting.

5-1. Procedure of Adjustment for Trial Run

1. Checking of wiring:
Confirm that wiring to connecting terminals has been properly done. Erroneous connection of the power line to weak current terminals such as the control input terminal may cause burnout.
2. Application of operating power:
If the instrument is energized without a control motor connected to it, it will result in position error.
3. Data input:
To use such functions as external operating input, event output, and setting of position upon occurrence of error, the necessary data should be input on the appropriate screens. It is convenient to record input data in "9. Record of Parameter Setting."
4. Confirmation of contents of input:
Confirm that all data to be set have been input properly.
5. Confirmation of the direction of revolutions, full close position and full open position.
Confirm by manual operation that the direction of revolution (direction of opening and direction of closing) of the control motor is correct. Inverse setting of the direction of revolution involves danger. Correct the wiring if that is the case with reference to "Cause of Trouble and Troubleshooting." You should also confirm the positions of the control motor in the fully closed condition (0%) and the fully opened condition (100%). If out of position, select "zero/span adjustment" manually or automatically and correct it.
6. Release manual operation and start automatic operation for a trial run.

5-2. Priority Order of Control Actions

1. Automatic operation (operation/suspension) and manual operation: (The following diagram shows the procedure of operation.)



2. In consideration of an emergency safety-threatening situation, manual operation is given top priority.
3. Manual operation is given the first priority.

5-3. Notes on Initialization following Data Change

1. When an event type is changed, the set value of the event is initialized (returns to its initial value). You have to set the value again.
2. When an analog output type is changed, analog output lower limit value and analog output higher limit value are initialized (return to their initial values). You have to set these values again.

6. Summary of Convenient Functions

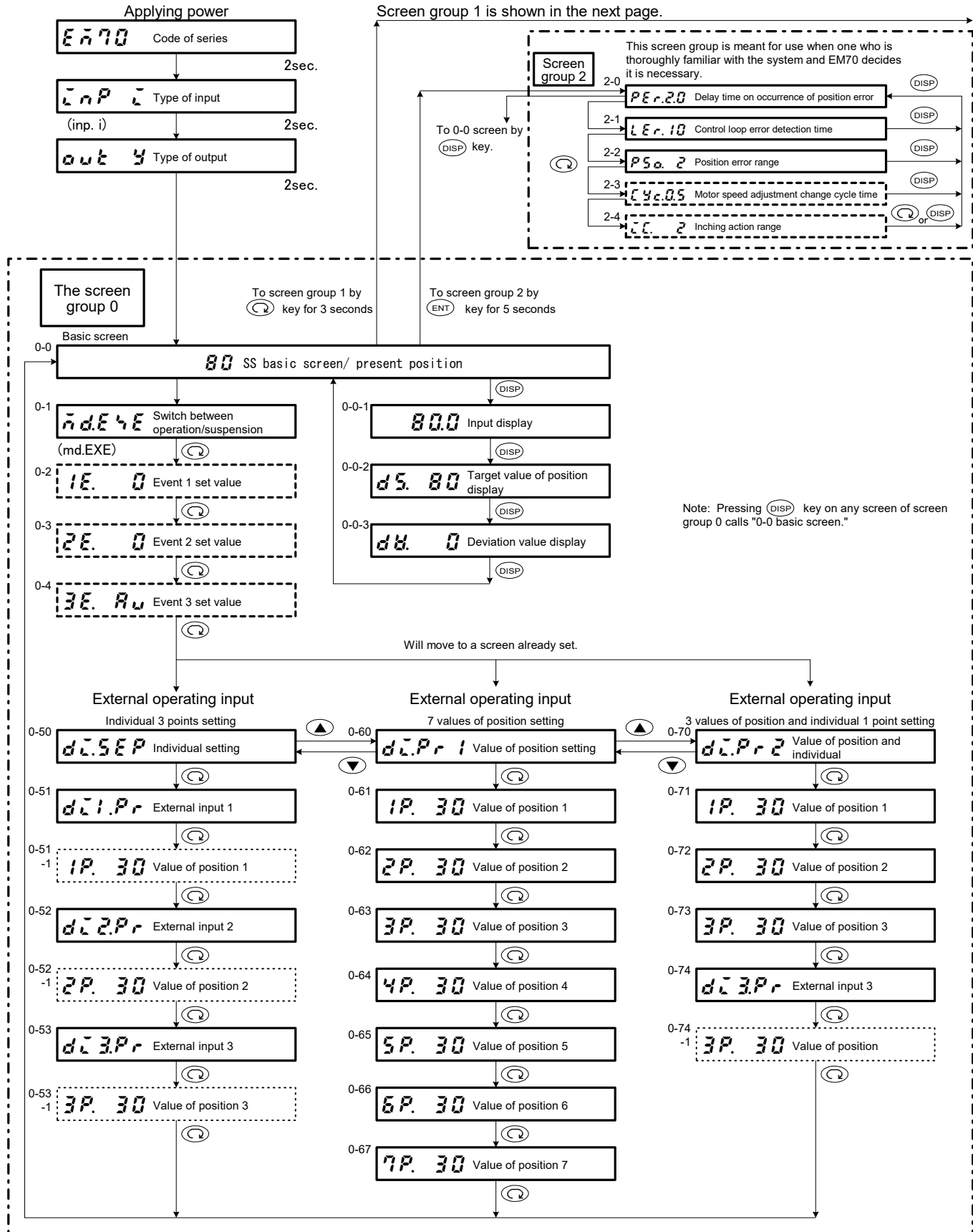
Function	Summary	Page
① Manual operation	For trial run and maintenance/inspection and in emergency, automatic operation is released and manual position control is enabled.	11
② Switching between run/stand-by	For trial run and maintenance/inspection or in an emergency, operation can be suspended (stand-by or waiting action). Then, the STBY lamp (green) on the front panel lights and control output stops.	12
③ External operation	For actions in automatic operation, switching of output characteristics, switching between operation and suspension, and position setting can be carried out by external input (no-voltage contact or open collector). In case position setting has been made, the position used during the automatic operation is changed to a newly set value. It takes an ON time of 0.2 seconds or longer for external input to become effective. The following three types of setting modes by external input are available:	13
1) Individual 3 points	Three in total are selectable, i.e., switching of output characteristics, switching between operation and suspension (stand-by), and position setting.	14
2) 7 values of position	In the mode used only for position setting, 7 values of position in total are selectable. In this case, external input signals are treated as binary numerals.	14
3) 3 values of position and individual 1 point	3 values of position and one individual setting (switching of output characteristics, switching between operation/suspension (stand-by) or position setting) are selectable.	15
④ Zero Span Adjustment	The position of the full closing and the opening of the control motor and the like are adjustable. Adjustments must be made before the testing operation.	16
⑤ Event (option)	Of the 9 functions; position higher/lower limit absolute value alarms, input from controller higher/lower limit absolute value alarms, automatic operation, manual operation, occurrence of position error, occurrence of error of input from controller error and control loop trouble; three can be selected as events (auxiliary output signals) for contact output.	17
⑥ Position at the time of error	A motor action which is safe enough at the time of a position error (error of electric potential input from control motor) or an input error (error of input signal from controller) can be set.	
1) In the case of position error	Selectable from 3 types: Suspension (stand-by action), closing and opening of motor by setting its action time.	17
2) In the case of input error	Selectable from suspension (stand-by action) and setting of position (0 to 100%).	17
⑦ Analog Output (Option)	The output of the position or the control input can be done. Scaling (reverse scaling) is possible.	17
⑧ Communication (option)	Communication setting is possible. For details, please refer to the communication instruction manual.	18
⑨ Input filter	To remove the noise content of input signals sent from controller.	18
⑩ Input scaling	To position output 0 to 100%, scaling (changing higher limit and/or lower limit) control output signal can be done freely in a range from - 10 to 110%.	18
⑪ Position scaling	To control input signal 0 to 100%, scaling (changing higher limit and/or lower limit) control output signal can be done freely in a range from - 10 to 110%.	18
⑫ Position limiter	Not effective during manual operation. This is the function to make limiters (limitation) work on higher and lower limits of opening. The function is used, for example, to avoid full opening or full closing.	19
⑬ Moter speed adjustment	In the case of combined output of SSR and contact, the motor speed can be adjusted by controlling ON time and OFF time of operating output to the motor during automatic operation.	19
⑭ Square root extraction function (option)	Control is carried out by opening/closing operation of the position, using the square of input as a target position value.	19
⑮ Keylock	Keylock means to lock keys so they cannot work when pressed. There are four selectable types of keylock: Without keylock; keylock of screen groups 1 and 2; all keylock except manual operation; and all keylock.	19

7. Explanation of Screens and Parameter Setting

7-1. Parameter Flow

Note: Three kinds of frame lines signify the following. The number on the left side of the frame indicates the screen number.

- Screens regularly shown by key operation and other means.
- Screens shown when appropriate options are added or selected.
- Screens shown only when selected in control action modes.



The screen group 1

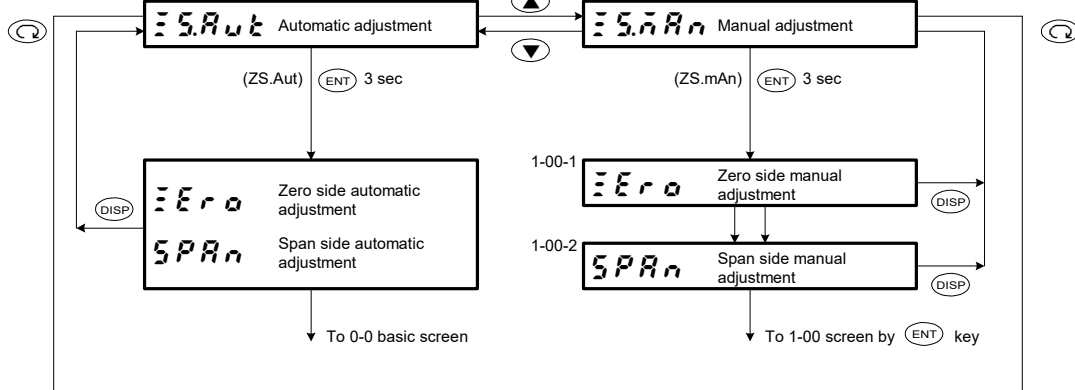
3 sec. from 0-0 basic screen

To move to either the 1-0 or 1-00 screens which are already set.

To the 0-0 screen by **DISP** key

The 1-0 zero/span automatic adjustment screen

The 1-00 zero/span manual adjustment screen



1-1 **E1 n.n** Event 1 type setting

1-2 **E1 d.0.1** Event 1 hysteresis

1-3 **E1 u.o.F** Event 1 stand-by action

1-4 **E2 n.n** Event 2 type setting

1-5 **E2 d.0.1** Event 2 hysteresis

1-6 **E2 u.o.F** Event 2 stand-by action

1-7 **E3 n.n** Event 3 type setting

1-8 **E3 d.0.1** Event 3 hysteresis

1-9 **E3 u.o.F** Event 3 stand-by action

1-10 **PEStP** Adjustment at the time of position error

1-11 **t. 300** Open/close time at the time of position error

1-12 **CELnP** Adjustment upon occurrence of input error

To the 1-13 screen

1-13 **Pr. 0** Value of position at the time of input error

1-14 **AN P** Analog output setting

1-15 **AL 0** Lower limit of analog output

1-16 **AM 100** Higher limit of analog output

1-17 **PtShn** Communication protocol

1-18 **Can L** Communication mode

1-19 **Ad. 1** Communication address setting

1-20 **b.1200** Communication rate setting

1-21 **dt.7E1** Communication data format setting

1-22 **ctL.1** Communication control code

1-23 **bCC.1** Communication BCC checking

1-24 **n.EEP** Communication memory mode

1-25 **dL.20** Communication delay time

1-26 **CanP.1** Communication mode type

To 1-27 screen

1-27 **r.4.20** Input range setting

1-28 **F. 0** Input filter setting

1-29 **ScL. 1** Input/position scaling

1-30 **L. 0** Lower limit of scaling

1-31 **H. 100** Higher limit of scaling

1-32 **PL 0** Lower limit of position limiter

1-33 **PH 100** Higher limit of position limiter

1-34 **10.100** Motor speed adjustment "G1" setting

1-35 **20.0F** Motor speed adjustment "G2" setting

1-36 **59.0F** Square root extraction setting

1-37 **Act.dA** Output characteristics setting

1-38 **db. 20** Dead band setting

1-39 **dFP.rP** Hysteresis setting

1-40 **PLc. 0** Keylock setting

To either 1-0 or 1-00 screen

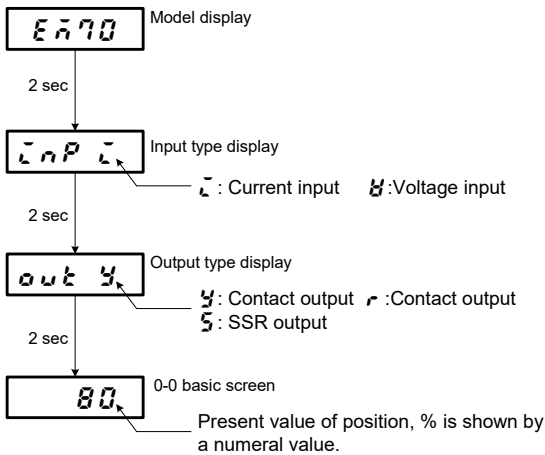
Note: When the **DISP** key is pressed on screens other than 1-0 or 1-00 screen at screen group 1, the screen will return to the 1-00 or 1-0 screen.
Also when the **ENT** key is pressed, the screen will return to the previous screen.

Before Setting

- Reminder 1: The mark affixed to a value or a character on each screen signifies that the setting is being changed. When the **ENT** key is pressed to register it, the **ENT** mark goes out.
- Reminder 2: In the event no key is pressed for more than 3 minutes on any screen, the display automatically returns to "0-0 basic screen."
Do not forget that if the basic screen returns while a change in setting is going on, newly set data will not have been registered.
- Reminder 3: When keylock is set and COM is selected as communication mode, setting by key operation is not possible.
- Reminder 4: External operating input is expressed as DI1, DI2 and DI3 and event output as EV1, EV2 and EV3.

7-2. Display upon Power-ON

When power is applied, initial screens upon power-ON are displayed successively, each for about 2 seconds to allow you to see the types of input and output of this instrument. Then, in about 2 seconds, the basic screen is displayed. From this screen, the display proceeds to screens for setting various functions by means of operating keys. For the order of screens to appear, refer to 7-1 Parameter Flow.



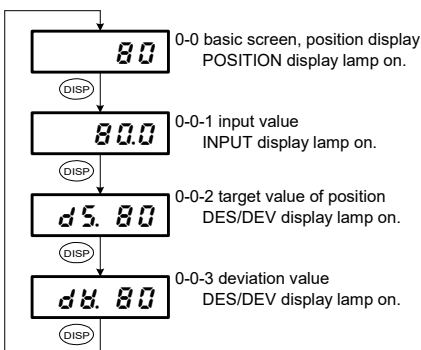
7-3. Explanation of Screen Group 0 and Parameter Setting

Method of key operation

The **ENT** key is used to proceed to the next screen, the **▲** and **▼** keys for selection on each setting screen and the **ENT** key for registration. (For a change of data display, see the following section.) On any of the screens in this screen group, except the ones described in (1) Changing Data Display, pressing the **DISP** key calls back the 0-0 basic screen.

(1) Changing Data Display

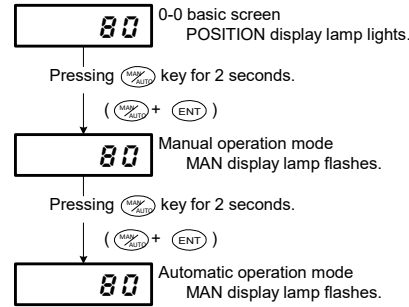
Pressing the **DISP** key on the 0-0 basic screen changes various display values.



1. **0-0 Basic screen:**
Present position value is displayed in %.
2. **0-0-1 Control input value display screen:**
Control input is displayed in %.
3. **0-0-2 Target position value display screen:**
Target position value is displayed in %. In case higher and lower limit limiters of position (See screen group 1.) are set, however, it is limited by limiter values.
4. **0-0-3 Deviation value display screen:**
A value obtained by deducting target position value from present position value is displayed. (Deviation value = position value - target position value). Even when deviation value exceeds -99%, -99% is displayed.

(2) Manual Operation

Manual operation (Manual/Auto and Open/Close are changed on the 0-0 to 0-0-3 screens.)

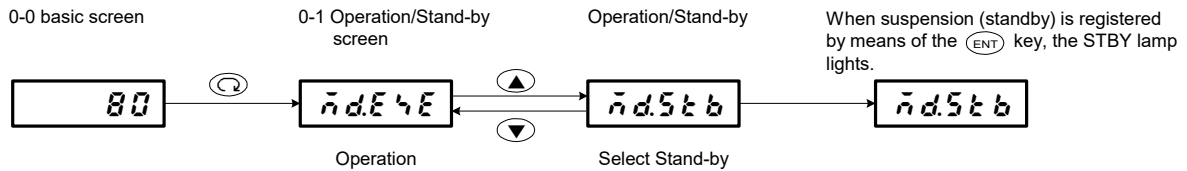


1. **Change from automatic operation to manual operation:**
Automatic operation is changed to manual operation when key is pressed for 2 seconds continuously on the basic screen. The MAN display lamp flashes. (This can be done alternatively by pressing **MAN/AUTO** key and **ENT** key simultaneously.)
2. **Key operation during manual operation:**
During manual operation, pressing the **▲** key lights the OPEN lamp and opening control output is produced. During manual operation, pressing the **▼** key lights the CLOSE lamp and closing control output is produced. Press the **▲** or **▼** key while watching the position display, and the intended position can be set.
3. **Releasing the manual mode:**
During manual operation, pressing the **MAN/AUTO** key for 2 seconds releases manual operation. The MAN lamp goes out and automatic operation begins. (Pressing the **MAN/AUTO** key and the **ENT** key simultaneously is alternate means to switch to Automatic operation.)
4. **Note on manual operation:**
During manual operation, the motor keeps operating at 100% speed regardless of a set speed. You should be observant for system information constantly during manual operation. Special care is required if you leave the site while manual operation is going on.

(3) Switch between Operation and Suspension

[0-1 operation screen: initial value: E4E Operation, 5tb Suspension]

Switch between Operation/Suspension is possible while Automatic Operation.



- Switch from operation to stand-by:
Pressing the ∇ key on the 0-1 operation/stand-by screen turns the display to $5t b$ as shown above. When the ENT key is pressed, the decimal point goes out and the STBY lamp lights. Then the operation is suspended.
- Switch from stand-by to operation:
Pressing the \blacktriangle key on the 0-1 operation/stand-by screen turns the display to $E4E$. When the ENT key is pressed, the decimal point as well as the STBY lamp goes out and operation is resumed.
- Note on switching:
When Stop (St) is selected for external control input DI, switching by the use of front panel keys is not possible.

(4) Setting of Event Set Value

[0-2, 0-3, 0-4 screen, initial value: no setting range: 0 to 100%]

In case the optional event output (3 points) function is added, it is possible to select different events and contact outputs are produced from the 3 points of EV1, EV2 and EV3.

1. Setting of Event Type

Before the setting, first set the event type.

Set the event type from "1-1 event 1 type setting screen", "1-4 Event 2 type setting screen" "1-7 event 3 type setting screen" in screen group 1. (When an event type is changed the set value will be initialized, so reset becomes necessary.)

Setting is possible when 4 types of events allowing event set values to be set, i.e., higher and lower limits of position and higher and lower limits of inputs as shown below:

4 types of alarms

LP : Lower limit of position, HP : Higher limit of position, LC : Lower limit of input, HC : Higher limit of input can be set when the setting is complete. Display of screen only no : No setting RU : Operation nR : Manual PE : Position error CE : Input error LE : Control Loop error

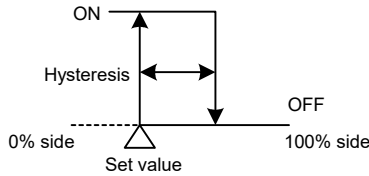
2. Event Set Value Setting (Use the table below for reference in setting.)

Code	Type	Description	Initial value	Automatic operation			Manual
			Setting range	Stand-by	Operation	DI	
no	None	No event action	Code display	OFF	OFF	OFF	OFF
LP	Position lower limit value	To be output when position value lowers below a set position.	0%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			0 to 100%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
HP	Position higher limit value	To be output when position value exceeds a set position.	100%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			0 to 100%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
LC	Control input lower limit value	To be output when control input value falls below a set value.	0%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			0 to 100%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
HC	Control input higher limit value	To be output when control input value exceeds a set value.	100%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			0 to 100%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
RU	Automatic operation	To be output during automatic operation.	Code display	OFF	ON	ON	OFF
nR	Manual operation	To be output during manual operation.	Code display	OFF	OFF	OFF	ON
PE	Position error	To be output when position value exceeds set values for position error range.	Code display	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CE	Control input error	To be output when control input value falls below -10% or exceeds +110%.	Code display	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
LE	Control loop error	To be output when feedback potentiometer input signal does not correspond to control output.	Code display	OFF	<input type="radio"/>	<input type="radio"/>	OFF

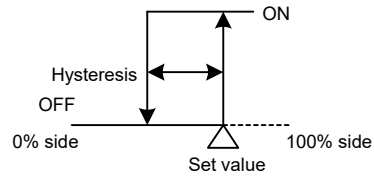
\circ : Effective (Action, depending on condition)

3. Event output action:

Position, control input lower value event action



Position, control input upper value event action



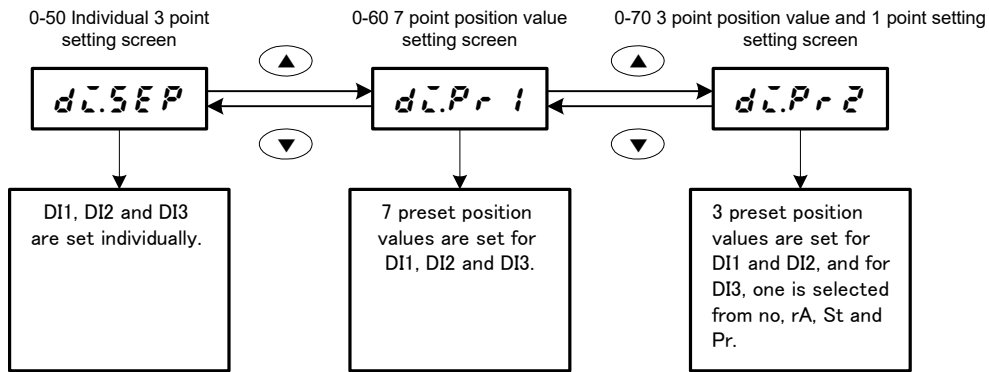
4. Event standby action:

In case ON is set for event standby action, event is not output even when control input is within an event action range (an ON range) upon applying power. Event is output only when it exceeds the event action range (i.e., enters an OFF range) and reaches the event action range again.

(5) Selection of External Operation Input (DI) from 3 Types

External input can break in and operate by no-voltage contact or an open collector signal while the instrument is in operation. There are 3 types of external input. Select from either individual 3 point setting, 7 point position value setting or 3 point position value and 1 point setting.

1. 3 type selection (Selection can be made as shown below)



2. About DI (type, action and setting range)

Type	Code	Action	Setting range
Individual setting (3 points)	<i>no</i>	Not effective	
	<i>rA</i>	Reversion (DI = ON RA action, DI = OFF DA action)	
	<i>St</i>	When DI = ON, automatic operation is suspended (standby)	
	<i>Pr</i>	Preset position value is set.	Initial value 0% 0 to 100%
Preset positing value setting (7 points)	<i>1P</i> to <i>7P</i>	Seven preset position values are set for DI1, DI2 and DI3.	Initial value 0% 0 to 100%
Present position value setting (3 points) and individual one point setting	<i>1P</i> to <i>3P</i>	Three preset position values are set for DI1 and DI2.	Initial value 0% 0 to 100%
	<i>no</i> <i>rA</i> <i>St</i> <i>Pr</i>	Individual setting for DI3 is the same as individual setting (3 points).	

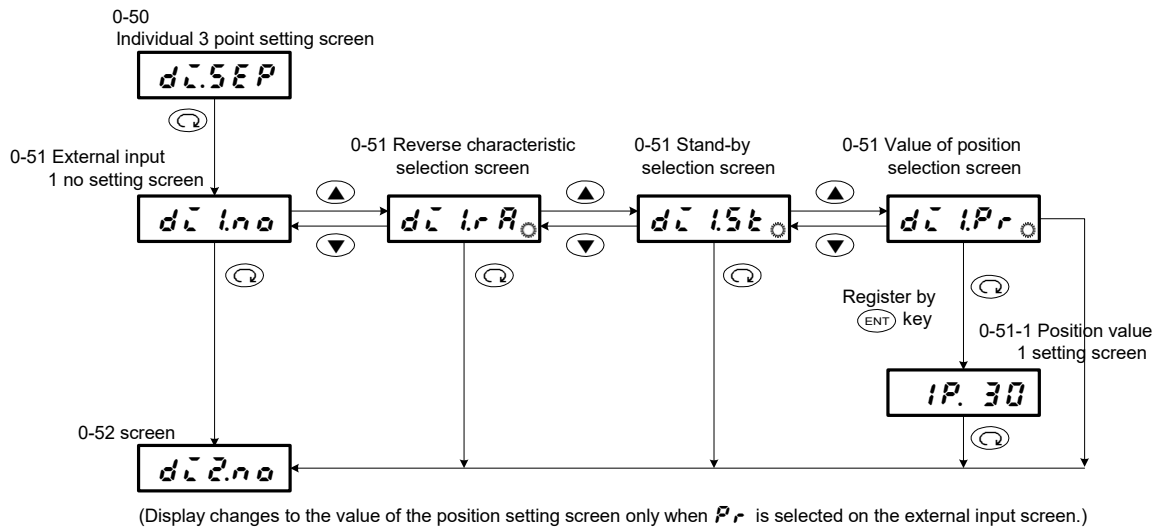
- 1) DI input is of level setting.
- 2) 0.2 second or longer is necessary from the time at which DI internal contact turns ON to the time at which the input action becomes effective.
- 3) If reversion of DI input control characteristic and suspension of automatic operation are selected and the selection of DI input is released while the action is being executed with DI=ON, the action status remains unchanged.
- 4) In case the same selection is made for DI1, DI2 and DI3, the action is carried out in the order of DI1>DI2>DI3.

(6) Setting of Individual 3 points of External Operating Input

[Initial value: *no* only.]

Switching of output characteristics, operation/suspension and position value (exclude no setting).

1. Selection of external operating input (The following diagram shows setting of external operating input 1 as an example.)



2. Setting of preset value of position

[Initial value: 0%, Setting range: 0 to 100%]

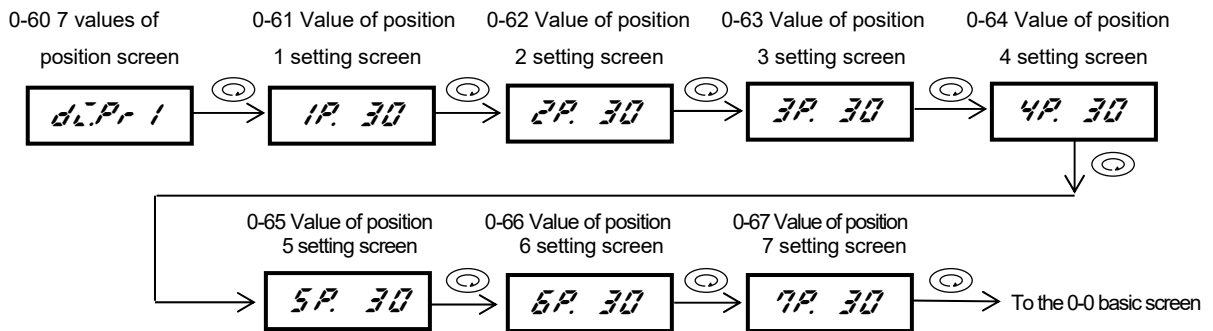
The display changes to the value of the position setting screen to allow you to set only when Pr is selected as the value of position on the 0-51, 052 and 0-53 external operating input screen.

(7) Setting of 7 point External Operating Input Position Value

[Initial value: 0%, Setting range: 0 to 100%]

Preset position value for 7 points (1P to 7P) can be set from DI 1, DI2, DI3.

1. Setting of value of position



2. Selection of the number of preset position values

Selection is made by binary through external operating input DI1, DI2 and DI13.

Selection of preset position values (1P to 7P) is as follows.

The ● mark signifies DI=ON.

External operating input	Automatic operation	Preset number of position values						
		1P.	2P.	3P.	4P.	5P.	6P.	7P.
DI1	OFF	●	OFF	●	OFF	●	OFF	●
DI2	OFF	OFF	●	●	OFF	OFF	●	●
DI3	OFF	OFF	OFF	OFF	●	●	●	●

(8) Setting of 3 Points of External Operating Input Position Values and Individual 1 point

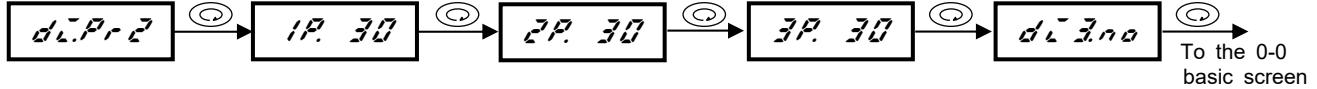
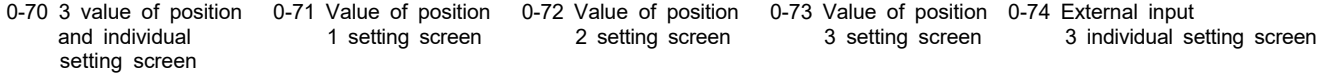
Three points in total of position setting and one point of individual setting (switching of output characteristics, switching of operation and suspension and position) are selectable.

1. Setting of position values

1) Setting of 3 values of position

[Initial value: 0%, Setting range: 0 to 100%]

The same setting method is applicable to 1 to 3 values of position. When the key is pressed, the display changes from the position value 1 setting screen to the position value 3 setting screen successively. Pressing the key on the position value 3 setting screen, the 0-0 basic screen returns. Set 3 values of position for two input points of DI1 and DI2. DI3 is set individually.



2) Selection of the number of preset position values (D11 and D12)

Selection is made by binary through external operating input DI1 and DI2.

Selection of preset position values (1P to 3P) is as follows.

The ● mark signifies DI=ON.

External operating input	Automatic operation	Preset number of position values.		
		1P.	2P.	3P.
DI1	OFF	●	OFF	●
DI2	OFF	OFF	●	●

2. Setting of individual 1 point (DI3)

On the 0-74 external input 3 operating screen individual setting screen

Selection is possible from the following; no: No setting (initial value), rR: Reverse characteristics, St: Standby (waiting), Pr: Value of position (preset). When value of position Pr is selected the 0-74-1 value of position setting screen is called.

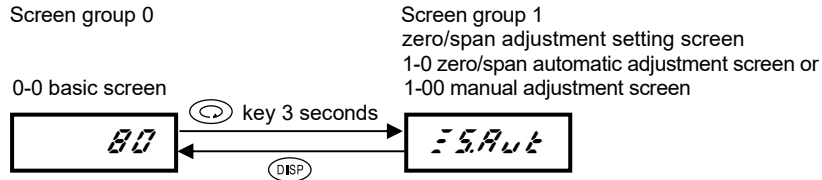
[Initial value of position: 0%, setting range: 0 to 100%]

7-4. Screen group 1 and parameter setting

There are various apparatus that have relation to the settings in screen group 1. Please have a person who is familiar with the apparatus conduct the setting.

1. Moving from Screen Group 0 to Screen Group 1

When the key is pressed continuously for 3 seconds, on the 0-0 basic screen, the 1-0 zero/span automatic adjustment screen or the 1-00 zero/span manual adjustment screen of the screen group 1 is displayed. To return to the 0-0 basic screen, press the key.



2. Need of Zero/Span Adjustment

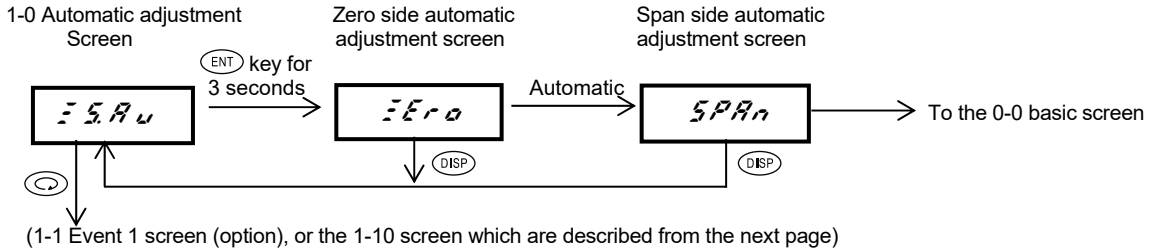
- 1) The zero span adjustment makes adjustment when the fully opened condition(100%) or the fully closed condition(0%) is reached in an incorrect position.
- 2) There are two types of adjustments, automatic and manual. Connected to a control motor or the like, the instrument checks and adjusts the zero side and the span side of the rotating position of the motor shaft. If getting out of a position is found at the time maintenance/replacement of the control motor, readjustment should be made.
- 3) Before using the instrument make sure to carry out zero/span adjustment.
- 4) Before zero/span adjustment, make sure to confirm that all wiring has been carried out correctly.
- 5) In some cases, erroneous wiring, if any, of terminals R1 and R2 is unable to be checked. You should be very careful to avoid erroneous wiring.
- 6) Confirm the direction of revolutions of the motor by the use of the and keys in Section 7-2 Manual Operation (2). Once it is confirmed, change manual operation to automatic. Zero/span adjustment is not possible in manual operation.

Use the and keys for switching between the 1-0 zero/span automatic screen and the 1-00 zero/span manual screen and the Key for registration.

(1) Zero/Span Automatic Adjustment

(1-0 Automatic adjustment screen **15.00** [Initial value], Zero side automatic adjustment screen **15.01** Span side automatic adjustment screen **15.02**)

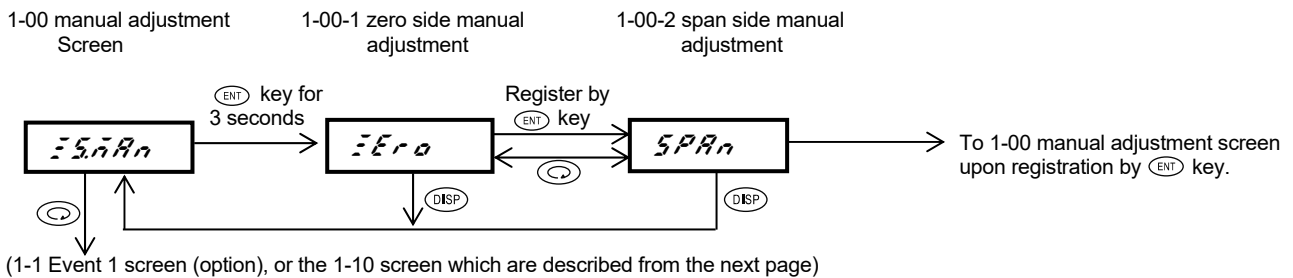
- 1) Press the **ENT** key on the 1-0 automatic adjustment screen for 3 seconds to proceed to the 1-0-1 zero/span automatic adjustment screen.
- 2) The screen will flash during the automatic adjustment.
- 3) During span side automatic adjustment, it is possible to interrupt automatic adjustment and return to the 1-0 automatic adjustment screen by using **DISP** key.
- 4) Upon completion of automatic adjustment, the display automatically changes to the 0-0 basic screen.



(2) Zero/Span Manual Adjustment

(1-00 manual adjustment screen **15.00**, 1-00-1 zeroside manual adjustment screen **15.01**, 1-00-2 span side manual adjustment screen **15.02**)

- 1) Pressing the **ENT** key for 3 seconds on the 1-00 manual adjustment screen calls the 1-00-1 zero side manual adjustment screen, which blinks while adjustment is going on.
- 2) Set the motor to the zero position (usually full close) by the use of **▲** and **▼** keys. When the **ENT** key is pressed for registration, the display changes to the 1-00-2 span side manual adjustment screen, which blinks.
- 3) Set the motor to the span position (usually full open) by the use of the **▲** and **▼** keys. When the **ENT** key is pressed for registration, the display changes to the 1-00 manual adjustment screen.
- 4) Pressing the **C** key during the zero side adjustment calls the span side adjustment screen and vice versa.
- 5) Pressing the **DISP** key during zero/span manual adjustment interrupts the manual adjustment and the display returns to the 1-00 manual adjustment screen.
- 6) In adjustment, the zero adjustment is on the closing side and the span adjustment is on the opening side.
- 7) Make sure to adjust so that span side data is larger than zero side data. When span side data is adjusted to be lower than the zero side data, it is taken as an error and an error message appears on the display.



Key Operation

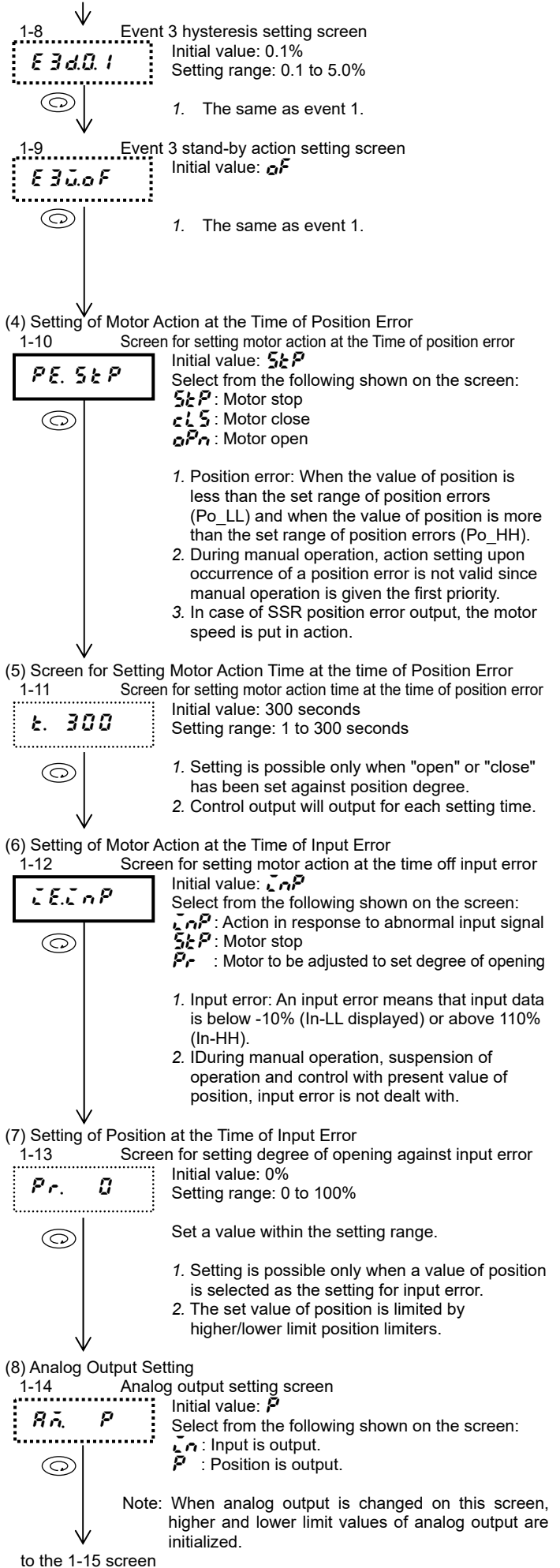
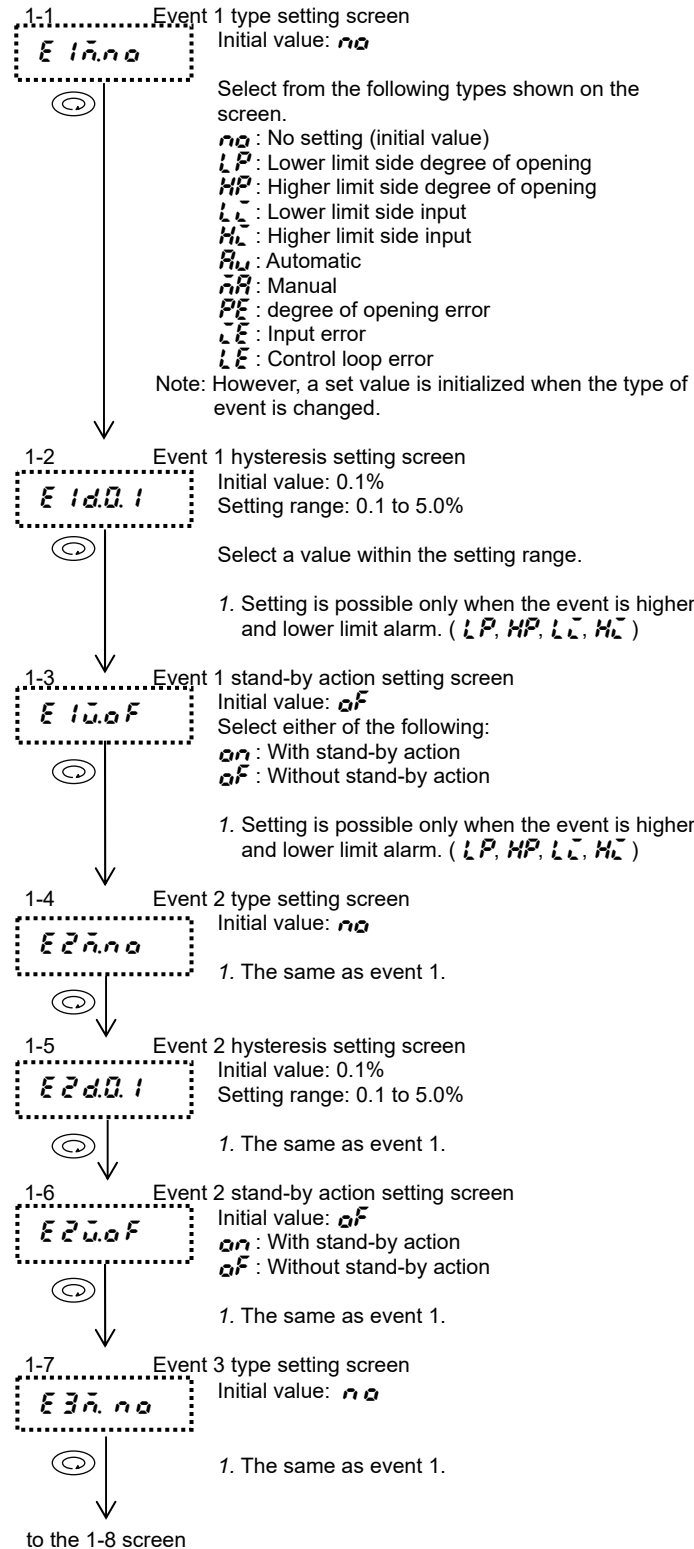
The **▲** and **▼** keys are used for selection on a screen and an item or a numerical value is registered by means of the **ENT** key. To return to the preceding setting screen, press the **MAX/AUTO** key. When the **DISP** key is pressed, the 1-0 or 1-00 basic screen is returned.

Screen Group 1

1-0 automatic adjustment screen or 1-00 manual adjustment screen is the starting screen.

On each of the following screens, a value within a setting range or an item from those displayed is selected and set.

(3) Event Setting



1-15 Lower limit side analog output setting screen
 Initial value: 0%
 Setting range: 0 to 100%
 Inversed scale is possible
 (lower limit value \neq higher limit value, though).

1-16 Higher limit side analog output setting screen
 Initial value: 100%
 Setting range: 0 to 100%
 Inversed scale is possible
 (lower limit value \neq higher limit value, though).

(9) Communication Setting
 For the communication mode, please refer to the communication instruction manual provided separately.

1-17 Communication protocol setting screen
 Initial value: *5hñ*
 Select from the following indications.:
5hñ: Shimaden Standard Protocol
ñ5c: MODBUS Protocol (ASCII Mode)
ñtñ: MODBUS Protocol (RTU Mode)
 Select the protocol for communication.

1-18 Communication setting screen
 Initial value: *l*
 Select from the following:
l: Communication local mode (initial value)
ñ: Communication mode

1. Key operation can make a change only from the communication mode to the communication local mode.
2. In communication mode, keylock is effective on all the setting screens except manual operation.

1-19 Communication address setting screen
 Initial value: 1
 Setting range: 1 to 255
 1. In case a plurality of controllers are linked for communication, addresses need to be set individually.

1-20 Communication rate setting screen
 Initial value: *1200*
 Set a value from the following shown on the screen:
1200: 1200 bps (initial value)
2400: 2400 bps
4800: 4800 bps
9600: 9600 bps
1920: 19200 bps
3840: 38400 bps

1. The speed of communication should be set correspondingly to that of the host computer.
2. Pressing the **ENT** key for 3 seconds changes the present speed of communication forcibly to interrupt communication and to change to the local mode. To restart communication, the speed should be set correspondingly to that of the host computer.

1-21 Communication data format setting screen
 Initial value: *7E 1*
 Select from the following:
7E 1: 7E1 *7E 2*: 7E2
7ñ 1: 7ñ1 *7ñ 2*: 7ñ2
8E 1: 8E1 *8E 2*: 8E2
8ñ 1: 8ñ1 *8ñ 2*: 8ñ2

1. The length of data bits, parity and the length of stop bits are set.

to the 1-22 screen

1-22 Communication control code setting screen
 Initial value: 1
 Setting range: 1, 2 and 3
 Select from the following shown on the screen:
 1: STX_ETX_CR
 2: STX_ETX_CRLF
 3: @:_CR

1. A communication control code is set.

1-23 Communication BCC check setting screen
 Initial value: 1
 Setting range: 1, 2, 3 and 4
 Select from the following shown on the screen:
 1: ADD
 2: ADD_two's cmp
 3: XOR
 4: None

1. BCC processing method to be used in BCC checking is selected.

1-24 Communication memory mode setting screen
 Initial value: *EEP*
 Select from the following shown on the screen:
EEP: EEPROM (initial value)
 Data is written in memory.
RAM: RAM
 Data is written in RAM.

1-25 Communication delay time setting screen
 Initial value: 20
 Setting range: 0 to 100
 1. Sets the delay time between receiving a communication command and sending it.
 2. Delay time = Set value of communication delay time \times 0.25 msec.

1-26 Communication mode types setting screen
 Initial value: 1
 Setting range: 1, 2
 Select from the following screen:
 1: Mode1
 2: Mode2

Set to mode 1 for the key operation during the writing process by communication if necessary.

Communication mode types	Mode1		Mode2	
	COM	LOC	COM	LOC
Communication mode				
Key operation	Possible		Not Possible	Possible
Communication writing	Possible		Possible	Not Possible

(10) Input Range Setting

1-27 Input range setting screen
 Initial value:
4.20 in the case of current input
0.10 in the case of voltage input

Select one from the following types of current input.

4.20: 4 to 20mA (initial value)
0.20: 0 to 20mA

Select one from the following types of voltage input.

0.10: 0 to 10V (initial value)
0.5: 0 to 5V
1.5: 1 to 5V

to the 1-28 screen

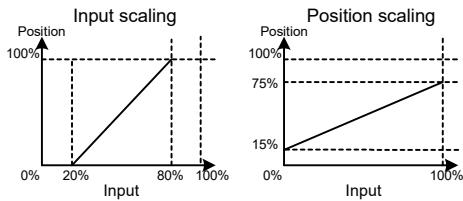
(11) Input Filter Setting
 1-28 Input filter setting screen
 Initial value: 0 second
 Setting range: 0 to 99 seconds

F. 0

1. A time constant of primary delay filter is set.
2. The influence of noise contained in control input signal is mitigated and control is stabilized.

(12) Setting of Input Scaling/Position Scaling
 1-29 Screen for setting input scaling/degree of opening scaling
 Initial value: **L**
 Select from the following shown on the screen:
L: Input scaling (initial value)
P: Scaling of degree of opening

1. When the setting of input scaling or scaling of the degree of opening is changed, lower and higher limit values of the scaling are initialized.



2. Input scaling: Higher and lower limit values of input are set respectively against 0% and 100% positions.
3. Position scaling: Higher and lower limit positions are set respectively against 0% and 100% inputs.

1-30 Scaling lower limit setting screen
 Initial value: 0%
 Setting range: -10 to 109%
 (lower limit < higher limit)

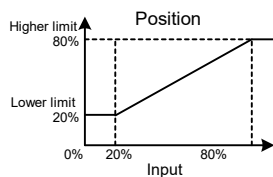
L. 0

1-31 Scaling higher limit setting screen
 Initial value: 100%
 Setting range: -9 to 110%
 (lower limit < higher limit)

H. 100

(13) Position Limiter Setting
 1-32 Screen for setting lower limit value of position limiter
 Initial value: 0%
 Setting range: 0 to 99%
 (lower limit < higher limit)

PL. 0



1-33 Screen for setting higher limit side value of position limiter
 Initial value: 100%
 Setting range: 1 to 100%
 (lower limit < higher limit)

PH. 100

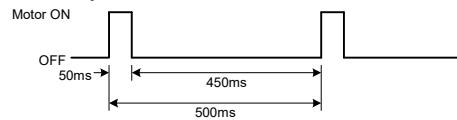
Position limiter is effective except during manual operation and position abnormality. Preset values of position through external operating input and preset values of position at the time of input error also become effective.

to the 1-34 screen

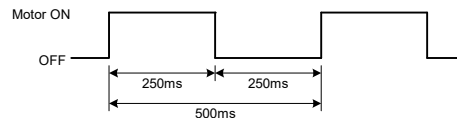
(14) Motor Action Time Setting

1. The motor speed is adjustable when SSR output is selected.
2. When the motor speed is adjusted, control is carried out with a set cycle time (initial value: 500 msec.) as one cycle.
3. It can be set for voltage/current input (automatic operation) and DI preset value operation respectively.

- In the case of 10% selected on the motor speed adjustment screen:



- Motor action time set at 50%



1-34 Motor speed adjustment "1G" setting screen
 Initial value: 100%
 Setting range: 10 to 100%

10. 100

When voltage / current input (automatic operation) is selected, motor speed adjustment is carried out with the parameter "1G".

1-35 Motor speed adjustment "2G" setting screen
 Initial value: **oF**
 Setting range: oF, 10 to 100%

20. oF

When DI preset Value operation is selected, motor speed adjustment is carried out with the parameter "2G". If set to "oF", motor speed adjustment is carried out with the parameter "1G".

(15) Setting of Square Root Extraction Function
 1-36 Screen for setting square root extraction function
 Initial value: **oF**

59 oF

Select from the following shown on the screen:
oN: With square root extraction
oF: Without square root extraction

1. Control is carried out by calculating opening/closing degrees, using the square of input as a target position value.

(16) Output Characteristics Setting
 1-37 Output characteristics setting screen
 Initial value: **dA**

Act.dA

Select from the following shown on the screen:
dA: Direct characteristics (initial value)
rA: Reverse characteristics

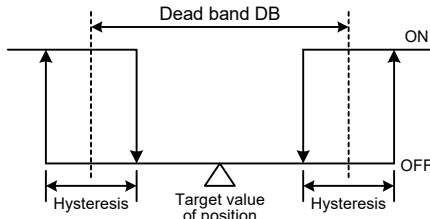
1. Direct characteristics (DA): Control is carried out in the state that the direction in which input increases and decreases is the same as the direction in which the value of position increases and decreases.
2. Reverse characteristics (RA): Control is carried out in the state that the direction in which input increases and decreases is opposite to the direction in which the value of position increases and decreases.

Note: In case **rA** is selected for external input, setting is not possible and the screen is for monitoring only.

to the 1-38 screen

(17) Dead Band (insensitive area) Setting
 1-38 Dead band setting screen
 Initial value: 2.0%
 Setting range: 0.2 to 10.0%

db. 2.0



In case the control motor has higher inertia, hunting (opening and closing are repeated without stopping) may be caused. To prevent this, set a larger value for dead band. When control of high precision is needed, a smaller value should be set for dead band. You must be very careful since smaller dead band tends to result in hunting.

(18) Hysteresis Setting
 1-39 Hysteresis setting screen
 Initial value: PrP
 Setting range: PrP, 0.1 to 5.0%

dF.PrP

When set to "PrP", hysteresis is fixed to 1/4 of dead band. If dead band is less than 0.8%, hysteresis is fixed to 0.2%.

(19) Keylock Setting
 1-40 Keylock setting screen
 Initial value: 0
 Setting range: 0, 1, 2 and 3

Plc. 0

Select from the following shown on the screen:
 0: Without keylock (initial value)
 1: Keylock of screen groups 1 and 2
 2: All keylock except manual operation
 3: All keylock
 (In case manual operation is set before setting keylock, however, operation by ▲ and ▼ keys is possible.)

To the 1-0 automatic adjustment screen or 1-00 manual adjustment screen.

7-5. Explanation of Screen Group 2 (Special Screen Group) and Setting

Data in this screen group should be set only by one with thorough knowledge of the EM70 series and the system. Generally, the instrument is usable without changing the initial values in this screen group.

In the screen group 2 (special screen group), setting and reading through communication is not possible.

Pressing the ENT key continuously for 5 seconds on the 0-0 basic screen calls the 2-0 screen of screen group 2 (special screen group).

To return to the 0-0 basic screen, press the DISP key on the 2-0 screen.

The screen group 2 comprises 4 special screens, of which the sequence is shown in the following.

Key Operation Method

Press the ◀ key to proceed to the next screen. Use the ▲ and ▼ keys for selection and the ENT key for registration on each setting screen. While selection is going on by the use of the ▲ and ▼ keys, the decimal point on the lower right side of the numerical value blinks. The blinking stops upon registration of the selection. When the DISP key is pressed on any screen except the 2-0 screen, the 2-0 screen returns onto display.

0-0 Basic screen

DISP ↑ ↓ ENT

(1) Setting Delay Time upon Occurrence of Position Error
 2-0 Screen for setting delay time upon occurrence of position error
 Initial value: 2.0 seconds
 Setting range: 0.0 to 9.9 seconds

PEr. 2.0

1. A delay time from the detection of position error to the position error is set.
2. If a position error occurs while the 0-0 basic screen is on display, the 0-0-2 position display screen returns and the 2 digits on the right blink to signify a position error.
3. If a position error occurs while any screen other than the 0-0 basic screen is on display, the POSITION lamp blinks.

(2) Setting Detection Time for Control Loop Error
 2-1 Control loop error detection time setting screen

LEr. 10

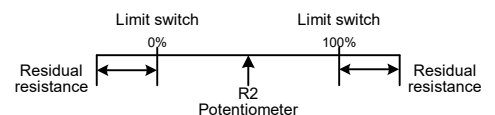
1. A control loop error means that a feedback potentiometer input signal does not correspond to control output. The response of the feedback potentiometer to control output changes in accordance with the speed of a control motor to be used. In case the speed of motor is high (the time between full close and full open is short) and it is intended to quicken the control loop error detection, a shorter detection time is set. In this case, lower motor speed tends to result in erroneous detection. An excessively low motor speed (the time between full close and full open is longer than 250 seconds) makes a change per unit time of the feedback potentiometer very small, leading to the possibility that a normal condition is taken as a control loop error. If this is the case, set a longer time for control loop error detection. Use 4% or more of the time between full close and full open as a guideline for your setting.
2. When a control loop error occurs on the DES/DEV display screen, the error message appears. At the same time, the 2 digits from the right blink and the DES/DEV lamp lights.
3. In case a control loop error and a position error occur simultaneously, the position error is given preference and the control loop error check is released.
4. Refer to the following formula in setting the control loop error detection time.
 Set value of control loop error detection time $> 4 \times T/G$
 T: Motor action time (second)
 G: Motor speed adjustment setting (%)
5. Even when a position error is not detected in the case of R1 or R3 break, it may be detected as a control loop error.

(3) Setting of Position Error Range
 2-2 Position error range setting screen

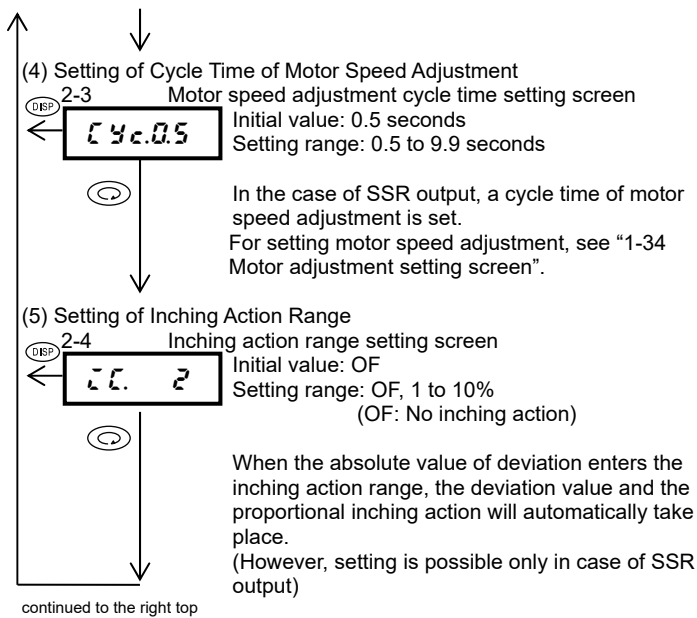
P5a. 2

Initial value: 2%
 Setting range: 1 to 10%

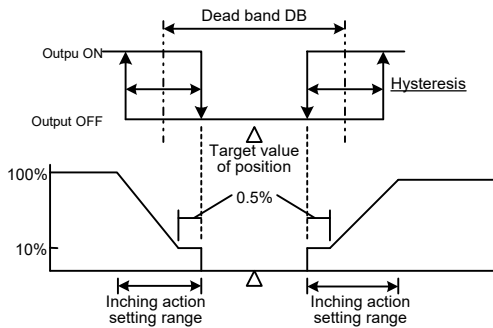
1. What percentage by which a position value is deviated from the 1 to 100% range is to be judged as a position error (position scaleover) is set.
2. In case the position error range is set at 3%, a value lower than -3% or more than 103% is judged as a position error.
3. In setting a position error range, a value to be set should be within a residual resistance range from the limiter switch to the potentiometer. A value set outside the residual resistance range is not taken as a position error but a control loop error is output.



to the 2-3 screen



Example: Relations of inching action, dead band and hysteresis.
 (When motor speed G=100%)



8. Maintenance and Troubleshooting

8-1. Action recovery from Power Failure

The state of operation before power failure returns. Nevertheless, EV output with standby action is put in the state of standby.

8-2. Procedure of Maintenance Replacement and Matters to Be Attended to

1. Confirmation of Model Code:

Check the model code of the component part in trouble.

2. Confirmation and Recording of Set Data:

Record parameters and numerical values set before replacing the instrument. (Please use 9. Record of Parameter Setting.)

3. Replacing and Wiring:

Record the wiring before replacement as the occasion demands and once replaced, wire carefully to avoid erroneous wiring. Make sure that power supply is turned off before starting wiring.

4. Setting and Confirmation of Parameters:

Following the replacement, set parameters and input numerical data with reference to, for example, the Record of Parameter Setting filled in. Please note that without such input, the same control action as before cannot be expected of the new instrument.

5. Trial Run and Adjustment:

After replacement with a new or repaired instrument, carry out trial run and adjustment following the instructions in 5-1 Procedure of and Notes on Adjustment for Trial Run.

8-3. Cause of Trouble and Troubleshooting

Problem	Cause	Remedy
①Error code is displayed.	Refer to "Error Codes, Causes and Remedies."	Refer to "Error Codes, Causes and Remedies."
②Directions of opening action and closing action are inverted.	①Erroneous wiring to potentiometer of control motor or for control signals. ②Erroneous setting of output characteristic (DA, RA).	①Correct wiring to potentiometer of control motor (terminals 4, 5, and 6) or for control signals (terminals 15, 16 and 17). ②Confirmation of setting and correcting output characteristics (DA, RA)
③Hunting (frequent repetition of turning round)	①Input to the instrument is instable. ②Dead band (insensitive area) is too small.	①Increase the dead band. ②Check wiring connection (terminals 2 and 3). ②Set input filter. ②For the sake of hardware, stabilize input signals.
④Full open or full close position is not correct.	①Zero/span position is not correct. ②Deterioration of potentiometer or some other part of control motor.	①Carry out zero/span adjustment. ②Examine and repair control motor.
⑤Control motor does not operate.	①Problem with power supply or wiring connection. ②Deterioration of control motor. ③Deterioration of EM70.	①□Check power source and wiring connection (terminals 4, 5 and 6), (terminals 11 and 12), (terminals 15, 16 and 17). ②Examine and repair control motor. ③Examine and repair or replace EM70.
⑥Display on the instrument front panel goes out and the instrument is unable to be put in operation.	①Problem with power supply or wiring connection. ②Deterioration of EM70.	①Examine power source and wiring connection particularly for burnout. (Terminals 11,12) ②Examine EM70 and repair or replace.
⑦Keys unable to be operated.	①Keylock is in effect. ②On communication setting screen, the communication mode (L) has been set. ③Deterioration of EM70.	①Release keylock. ②Change the communication setting to the local mode(L). ③Examine and repair or replace EM70.

8-4. Error Codes, Causes and Remedies

Error codes	Problem	Cause	Remedy
Po.HH (Po-HH)	Position higher limit error: Position value exceeds higher limit (as set for position error range). Initial value: 103% (When the screen is not displayed, the POSITION indicator light flashes.)	①Problem in wiring connection of feedback potentiometer. ②Control motor trouble.	①Check and confirm wiring connection to feedback potentiometer (terminals 4, 5 and 6). ②Check, repair or replace control motor.
Po.LL (Po-LL)	Position lower limit error: Position value falls below lower limit (as set for position error range). Initial value: -3% (When the screen is not displayed, the POSITION indicator light flashes.)	①Problem in wiring connection of feedback potentiometer. ②Control motor trouble.	①Check and confirm wiring connection to feedback potentiometer (terminals 4, 5 and 6). ②Check, repair or replace control motor.
in.HH (in-HH)	Input higher limit error: Control input signal exceeds higher limit (110%). (When the screen is not displayed, the INPUT indicator light flashes.)	①Mismatch between input range and control input signal. ②Problem with input circuit of EM70.	①Check and confirm input range and control input signal. ②Check, repair or replace EM70.
in.LL (in-LL)	Input lower limit error: Control input signal falls below lower limit (-10%). (When the screen is not displayed, the INPUT indicator light flashes.)	①Problem with wiring connection for control input signal. ②Mismatch between input range and control input signal. ③Problem with input circuit of EM70.	①Check and confirm wiring connection for control input signal (terminals 2 and 3). ②Check and confirm input range and control input signal. ③Check, repair or replace EM70.
ZS.Er (ZS-Er)	Zero/span adjustment error: Error occurred on zero/span adjustment screen.	①Problem with wiring connection to control motor. ②Span side and zero side adjusted inversely.	①Check wiring connection to potentiometer of control motor, particularly for burnout. (Terminal 4, 5 and 6), (Terminals 15, 16 and 17) ②Check wiring connection for control signal of control motor, particularly for burnout.
LP.Er (LP-Er)	Control loop error: Feedback potentiometer input signal does not change correspondingly to control output.	①Problem with wiring connection to feedback potentiometer. ②Deterioration of control motor. ③Mismatch between motor speed and control loop error detection time.	①Check and confirm wiring connection to feedback potentiometer (terminals 4, 5 and 6), (terminals 15, 16 and 17). ②Check, repair or replace control motor. ③Check and change set time for the detection of control loop error (to a somewhat larger value).

Note: If the product is found to be out of order, we ask you to re-read the instruction manual and examine the product again before calling us for our assistance.
When you notice something is wrong with the product or need further information, please contact our nearest agent or sales office.

9. Record of Parameter Setting

(For convenience sake, recording set values and selected items is recommended.)

Screen No.	Parameter (Item)/screen display	Initial value	Setting/Selection	Record
0-1	Operation/Suspension switching	md. (nd)	E4E	
0-2	Event 1 set value	1E. (1E)	no	
0-3	Event 2 set value	2E. (2E)	no	
0-4	Event 3 set value	3E. (3E)	no	
0-50	External input individual 3 points setting	di. (di)	SEP	
0-51	External input 1 individual setting	di1. (di1)	no	
0-51-1	External input 1 value of position setting	1P. (1P)	0	
0-52	External input 2 individual setting	di2. (di2)	no	
0-52-1	External input 2 value of position setting	2P. (2P)	0	
0-53	External input 3 individual setting *1	di3. (di3)	no	
0-53-1	External input 3 value of position setting *2	3P. (3P)	0	
0-60	Binary 7 values of position setting	di. (di)	Pr1	
0-61	Value of position 1 *3	1P. (1P)	0	
0-62	Value of position 2 *4	2P. (2P)	0	
0-63	Value of position 3 *5	3P. (3P)	0	
0-64	Value of position 4	4P. (4P)	0	
0-65	Value of position 5	5P. (5P)	0	
0-66	Value of position 6	6P. (6P)	0	
0-67	Value of position 7	7P. (7P)	0	
0-70	Binary 3 values of position and individual 1 point	di. (di)	Pr2	
0-71	Value of position 1 *3	1P. (1P)	0	
0-72	Value of position 2 *4	2P. (2P)	0	
0-73	Value of position 3 *5	3P. (3P)	0	
0-74	External input 3 individual setting *1	di3. (di3)	no	
0-74-1	External input 3 value of position *2	3P. (3P)	0	
1-0	Zero/span adjustment	ZS. (ZS)	Aut	
1-1	Event 1 type setting	E1m. (E1m)	no	
1-2	Event 1 hysteresis	E1d. (E1d)	0.1	
1-3	Event 1 stand-by action	E1W. (E1W)	aF	
1-4	Event 2 type setting	E2m. (E2m)	no	
1-5	Event 2 hysteresis	E2d. (E2d)	0.1	
1-6	Event 2 stand-by action	E2W. (E2W)	aF	
1-7	Event 3 type setting	E3m. (E3m)	no	
1-8	Event 3 hysteresis	E3d. (E3d)	0.1	
1-9	Event 3 stand-by action	E3W. (E3W)	aF	
1-10	Control at the time of position error	PE. (PE)	SEP	
1-11	Opening/closing time at the time of position error	t. (t)	300	
1-12	Control at the time of input error	IE. (IE)	LnP	
1-13	Opening/closing time at the time of input error	Pr. (Pr)	0	
1-14	Analog output	Am. (Am)	P	
1-15	Lower limit side analog output	AL. (AL)	0	
1-16	Higher limit side analog output	AH. (AH)	100	
1-17	Communication protocol	Pt. (Pt)	Shn	
1-18	Communication	Com. (Com)	L	
1-19	Communication address	Ad. (Ad)	1	
1-20	Communication rate	b. (b)	1200	
1-21	Communication data format	dt. (dt)	7E1	
1-22	Communication control code	CTL. (CTL)	1	
1-23	Communication BCC check	bCC. (bCC)	1	
1-24	Communication memory mode	m. (m)	EEP	
1-25	Communication delay time	dL. (dL)	20	
1-26	Communication mode types	Comy. (Comy)	1	
1-27	Input range: Current	r. (r)	4.20	
	Voltage	r. (r)	0.10	
1-28	Input filter	F. (F)	0	
1-29	Scaling	ScL. (ScL)	L	
1-30	Lower limit side scaling	L. (L)	0	
1-31	Higher limit side scaling	H. (H)	100	
1-32	Lower limit side position limiter	PL. (PL)	0	
1-33	Higher limit side position limiter	PH. (PH)	100	
1-34	Motor speed adjustment "1G"	1G. (1G)	100	
1-35	Motor speed adjustment "2G"	2G. (2G)	aF	
1-36	Square root extraction	Sq. (Sq)	aF	
1-37	Output characteristics	Act. (Act)	dR	
1-38	Dead band	db. (db)	20	
1-39	Hysteresis	dF. (dF)	PrP	
1-40	Keylock	KLc. (KLc)	0	
2-0	A delay time from the detection of position error	PEr. (PEr)	20	
2-1	Detection Time for Control Loop Error	LEr. (LEr)	10	
2-2	Position Error Range	PSo. (PSo)	2	
2-3	Cycle Time of Motor Speed Adjustment	Cyc. (Cyc)	05	
2-4	Inching Action Range	ic. (ic)	aF	

Memo

10. Specifications

- Display
- Position indicator
 - ◆ Output display color (LED bar graph) : Green
 - ◆ Display resolution/dot : 5%/20 dots
- Data display
 - ◆ Display digit/color : 5 digits/7 segments LED green display, Height of character: 14 mm
 - ◆ Display resolution : 1% (position, target value of position)
 - ◆ Accuracy : 1%FS±1digit
 - ◆ Display range : -10.0 to 110.0%
- Control input display (DATA, DISPLAY)
 - ◆ Resolution : 0.1%
 - ◆ Accuracy : 0.3%FS±1digit
 - ◆ Display range : -10.0 to 110.0%
- Sampling cycle : 0.2 seconds
- Status display : 15 types, LED lamp display
 - ◆ Position display : (POSITION)/Green
 - ◆ Control Input display : (INPUT)/Green
 - ◆ Target value of position/deviation display : (DES/DEV)/Green
 - ◆ Manual action : (MAN)/Green
 - ◆ Reverse action : (RA)/Green
 - ◆ Opening action : (OPEN)/Green
 - ◆ Closing action : (CLOSE)/Green
 - ◆ External control input : (DI1, 2, 3)/Green
 - ◆ Event action : (EV1, 2, 3)/Orange
 - ◆ Stand-by action : (STBY)/Green
 - ◆ Communication status : (COM)/Green
- Control input
- Current/receiving impedance : 4 to 20, 0 to 20 mA DC/100Ω
- Voltage/input impedance : 1 to 5V, 0 to 5V, 0 to 10V DC/1MΩ
- Input filter : 0 to 99 seconds
- Isolation : Non-insulated from Feedback potentiometers, DI and System
Insulated from Analog output, Communication, Event, Control output and Power supply
- Setting
- Setting system : By key switches (6 keys) on front panel
- Setting/selection item
 - ◆ Display switching : By DISP key switch on front panel
 - ◆ Auto/manual switching : By MAN/AUTO key switch on front panel
 - ◆ Zero/span adjustment : Provided with Automatic adjustment function; manual adjustment is also possible (correction of potentiometer error)
 - ◆ Selection of control characteristics : Direct (DA)/reverse (RA)
 - ◆ Control characteristics gain setting : Input values corresponding to 0% position and 100% position (scaling function) or position values corresponding to 0% input and 100% input (scaling function)
 - ◆ Position limiter setting : Higher limit value 1 to 100%, Lower limit value 0 to 99% (higher limit>lower limit)
 - ◆ Setting of speed : 10 to 100% Unsettable in case of contact output (Y or R) (Initial value: No inching at 100%)
 - ◆ Dead band setting : 0.2 to 10.0% of input signal (Initial value: 2.0%)
 - ◆ Hysteresis : PrP, 0.1 to 5.0%
1/4 of dead band. Fixed to 0.2% when dead band is less than 0.8% of input.
 - ◆ Keylock : 3-stage lock
- Feedback potentiometer
- Usable range : Arbitrary between 100Ω to 2kΩ/ three-wire type
- Excitation voltage : About 1V
- Isolation : Non-insulated from Control input, DI and System
Insulated from Analog output, Communication, Event, Control output and Power supply
- Control output
- Output type : (Y or R) mechanical relay contact 240V AC 2A
(S) AC SSR(combination of mechanical relay contact and SSR)
240V AC 2A Minimum load current 30mA
- Isolation : Insulated from other I/O, System and Power supply
- External operation input (DI)
- Number of points : 3 points (DI1, DI2 and DI3)
- Operable items : (1) Individual assignment to RA, STBY and present position value is possible.
(2) Assignment to 7 preset position values by binary numerals is possible.
(3) Assignment to 3 present position values and individual assignment to one of RA, STBY and preset position value is possible.
- Operation : Put in action when no-voltage contact or open collector turns ON.
- Isolation : Non- insulated from Control input,
Insulated from Analog output, Communication, Event, Control output and Power supply

- Event output (option)
 - Number of event points : 3 points (EV1, EV2 and EV3)
 - Types : Value of Position (higher limit, lower limit, hysteresis variable and stand-by action selectable),
Input (higher limit, lower limit, hysteresis variable and stand-by action selectable),
Operation, manual, potentiometer error, input error, and control loop trouble.
- Output rating/structure : 240V AC 1A Resistive load/"a" contact
- Action display : When EV1 to EV3 are in action, orange lamp lights.
- Isolation : Insulated from other I/O, System and Power supply

- Analog output (option)
 - Number/type : 1 point, either position or control input to be selected
 - Analog output/rating : 4 to 20 mA/Load resistance 300Ω or less
 - Output scaling : Inverse scaling possible (lower limit≠higher limit)
 - Output accuracy : ±0.5% FS or less
 - Isolation : Insulated from other I/O, System and Power supply

- Square root extraction (option)
 - Position output control by square root extraction of input signals

- Communication function (option)
 - Communication type : RS-232C, RS-485
 - Communication system : RS-232C/3-line type half duplex system, RS-485/2-line type half duplex multi-drop (bus) system
 - Communication synchronization method : Half duplex asynchronous system
 - Communication protocol : Shimaden Standard Protocol/MODBUS ASCII/MODBUS RTU
 - Communication rate : 1200, 2400, 4800, 9600, 19200, 38400 bps
 - Communication mode types : Mode1/Mode2
 - Isolation : Insulated from other I/O, System and Power supply

- General specifications
 - Data storage : Non-volatile memory
 - Operating ambient temperature/humidity range : -10 to 50°C/90% RH or less (no dew condensation)
 - Storage temperature : -20 to 65°C
 - Supply voltage : 100 to 240V AC±10% 50/60Hz
 - Power consumption : 13VA (240V AC)
 - Conformity with standards
 - Safety : IEC61010-1 and EN61010-1
EN IEC 61010-2-030
 - EMC : EN61326-1
 - Insulation resistance
 - Between input/output terminals and power terminal : 500V DC 20MΩ or above
 - Between power terminal and ground terminal : 500V DC 20MΩ or above
 - Dielectric strength
 - Between input/output terminals and power terminal : 3000V AC 1 minute
 - Between power terminal and ground terminal : 1500V AC 1 minute
 - Protective structure : Only front panel has dust-proof and drip-proof structure. (IP66 equivalent)
(However, only for plate thickness 1.2 to 3.2mm)
 - Material of case : PPE resin molding (equivalent to UL 94 V-1)
 - External dimensions : H96 ×W96 ×D111 (Panel depth: 100) mm
 - Mounting : Push-in panel (one-touch mount)
 - Panel thickness : 1 to 4 mm
 - Panel cutout : 92 ×92 mm
 - Weight : Approximately 460 g

The contents of this manual are subject to change without notice.

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